

**SALT TOLERANCE AND FACTORS AFFECTING CRAWFISH PRODUCTION
IN COASTAL MARSHES**

By

W. Guthrie Perry, Jr.
Louisiana Wild Life and Fisheries Commission
Grand Chenier, Louisiana

Presented at the Second Annual Meeting of the
Louisiana Crawfish Farmers Association
September 14, 1971
University of Southwestern Louisiana
Lafayette, Louisiana

SALT TOLERANCE AND FACTORS AFFECTING CRAWFISH PRODUCTION IN COASTAL MARSHES

Crawfish are utilized as a food and recreational resource in Louisiana to a much greater degree than in any other state. The annual crawfish harvest varies from six to ten million pounds. This variation is caused principally by erratic water fluctuation in the Atchafalaya River Floodway, which produces more than 50 percent of the annual crawfish crop.

Since 1965, interest in crawfish farming has significantly increased. Crawfish farmers are able to control water levels and produce satisfactory crops with less annual variation than that experienced in natural areas. Generally, crawfish farmers produce earlier crops which command higher prices. Many crawfish farmers have realized per-acre net profits greater than those realized on more common field crops. Recent information indicates that there are approximately 18,000 acres of land devoted to crawfish farming in Louisiana. Even with this quantity of land, good farmland for economically feasible production is scarce.

A recent survey of coastal Louisiana's four million acre coastal marshes revealed that a minimum of a half million acres met the requirements of crawfish farmland, providing salinity concentrations were not detrimental.

It is the purpose of this paper to familiarize the reader with some of the early studies concerning crawfish production in

the lower coastal marshes and to discuss some of the problems involved.

Marsh Farming Research and Production

One of the limiting factors affecting crawfish production in the marshes is salinity. Salinity is a term describing the amount of salts dissolved in water. For all practical purposes we may say that we are speaking of the sodium chloride salts since these make up a large majority of those dissolved in sea water. The measure of these salts in a solution gives us a tool for comparisons of different waters. The concentration of salinity is usually expressed in parts per thousand (ppt). This is the weight in grams of salts dissolved in one kilogram of seawater.

The salinity of open seas generally ranges between 33 and 38 ppt, with the average being near 35 ppt. Salinity can be determined chemically by silver nitrate titration, using potassium chromate as an indicator or by mercuric nitrate titration. Electrical conductivity and density measurements obtained by the use of hydrometers are two other methods used.

Laboratory Studies.

Laboratory studies were conducted by Harold Loyacano at Louisiana State University in 1966-1967 in order to determine acute and chronic effects of salinity on red swamp crawfish and to compare the salinity tolerance of an inland population to a coastal marsh

population.

Loyacano collected crawfish from Ben Hur Farm, East Baton Rouge Parish, and from Grand Chenier, Cameron Parish, Louisiana. The sizes of crawfish that he tested were newly hatched young, 8 to 9 mm in total length; intermediate, 30, 40, to 50 and 60 mm in total length; and adult, 90 to 120 mm in total length. Salinities tested were 0, 10, 15, 20 and 30 ppt. Crawfish of equal length from each site were compared.

Survival of young was tested for one week in 0, 10, 15, 20 and 30 ppt salinity. Survival of intermediate and adult crawfish was tested for one week in 0, 10, 20 and 30 ppt salinity. Growth of intermediate crawfish was tested in these different salinities for four weeks.

His results were as follows:

1. Newly hatched red swamp crawfish were killed in less than one week in salinities of 15, 20 and 30 ppt. Intermediate crawfish, 30 mm total length, withstood salinities up to 20 ppt, but died in 30 ppt in less than one week. Adult crawfish, 40 to 120 mm, showed no significant mortality after one week in salinities up to 30 ppt.

2. Growth varied inversely with salinity. Thirty-millimeter crawfish exposed to salinities of 0, 10, 20 and 30 ppt for four weeks grew very little when fed fresh fish flesh, tropical fish food pellets and Oedogonium sp. Crawfish, 40 to 50 mm total length held in 0, 10 and 20 ppt salinity for four weeks had

average increases in weight of 4.4, 13.5 and 4.9 percent, respectively, when fed mixed green algae; although they ate the algae continually. Those in 10 ppt grew faster than those in 0 and 20 ppt.

3. Molting occurred in 20 percent each of those crawfish in 0 and 10 ppt, 12.5 percent of those in 20 ppt and 2.5 percent of those in 30 ppt.

Loyacano reported that crawfish in some experiments seemed to grow faster in concentrations up to 10 ppt, possibly because of the increased essential minerals in the more saline water. He further stated that this may be the maximum saltwater concentration that crawfish could tolerate osmotically.

Field Studies.

The Louisiana Wild Life and Fisheries Commission began studies in the spring of 1967 in order to obtain more information on the salinity tolerance of the commercially important red swamp crawfish under conditions approximating those found on commercial farms. This was to enable us to make more definite recommendations to coastal farmers and to those whose water sources may contain salt. The LSU studies had not included the actual breeding and reproductive cycles and had consisted of controlled studies confined to laboratory conditions.

In an attempt to go beyond the aquaria test adult crawfish were purchased from a freshwater area and stocked into a six acre

brackish water pond at the Rockefeller Refuge, Grand Chenier, Louisiana. The crawfish were stocked at a rate of 89 pounds per acre and the pond was managed using the commonly accepted techniques of commercial crawfish farmers.

Records were taken and maintained for water temperature, salinity, pH and for the presence of crawfish throughout the growing periods.

After survival and reproduction was realized production was determined. Population samples taken in the fall of 1967 and the fall of 1968 were correlated with the monthly salinities recorded during the study and indicated the following:

1. It was concluded from field data collected over a two year interval that crawfish bred in waters containing maximum salinity concentrations ranging from 6.0 to 8.0 ppt.

2. That between the dates of September 15 to October 15 egg laying and hatching occurred at salinities ranging from 4.4 to 7.9 ppt.

3. The harvest period, including the growing and breeding stages which extends from October 15 to draining, had salinities ranging from 3.1 to 8.0 ppt.

4. Projected possible catch figures calculated resulted in a total harvest projection of 1,525.0 pounds or 272.3 pounds per acre. This is considered minimal since other commitments prohibited intensive harvesting during the entire period.

5. Data is still not complete enough to make any definite statements regarding the maximum salinities in which the red swamp crawfish can be successfully farmed.

It is suggested, however, that crawfish subjected to a sudden increase or decrease in salinity concentrations may totally or partially fail to complete its reproductive processes if the gradient is sufficient.

A recent study has been conducted to evaluate crawfish production in impoundments managed for waterfowl on Rockefeller Wildlife Refuge. Water levels and quality control are manipulated in the intermediate to freshwater impoundments in much the same pattern as in crawfish farming. This is to encourage the natural growth of annual grasses such as wild millet (Echinochloa walteri), sprangletop (Leptochloa fascicularis), spike rush (Eleocharis sp.) and nut grass (Cyperus sp.). These are choice waterfowl foods and can be maintained on an annual basis by rhythmic summer drying and fall flooding without planting.

It was found that crops of crawfish could also be produced on an annual basis when the impoundments were properly managed. In addition to the above plants the crawfish have the more choice lower-story vegetation such as alligator grass (Alternanthera philoxeroides), primrose (Jussiaea alterniflora) and various smart weeds to feed on.

This is not to be confused with a cultivated situation where

the land has been cleared of everything and planted in millet or some other duck food. In this type duck management it's possibly true that a few more ducks may use the area but it is very doubtful if there would be enough cover and food for the crawfish.

Discussion of Problems

Marsh pond construction offers a little different situation because of the semi-fluid nature of the soil. Pond levees are usually built using either pontoon draglines or conventional draglines on mats. In the construction of ponds on Rockefeller Refuge, Grand Chenier, Louisiana, a maximum levee height of three to four feet during an initial placement was adhered to. This was to prevent the excessive levee weight from damaging the foundation. Also, a berm of at least 12 feet was left to prevent the levees from sluffing. New levees are usually allowed to dry from six months to a year before they are reshaped and dressed. A finished grade of approximately four feet above marsh level was found adequate; however, it must be remembered that levees may experience as much as 60 percent shrinkage. Sufficient elevations to prevent flooding or overflowing backwater are necessary.

An adequate water supply must be provided if the pond is to be successful. A prospective coastal farmer will have to be certain that a source of good water is ready for the initial flooding as well as for circulation and aeration during the warmer months.

He must keep in mind that his pond salinities may increase with summer evaporation and it will be necessary to dilute with less saline water. A close surveillance of the coastal water salinities must be maintained as our recent data indicate that crawfish will not do well in concentrations in excess of 6 ppt.

The distribution of saline waters in a marsh is closely related to the shape and drainage pattern of the basin or channel. Tides, currents, relative water volume, and evaporation are all important influences upon marsh salinity. Generally, the flushing action of freshwater is sufficient to maintain a pattern of increasing salinity toward the gulf. Saltwater is more dense or heavier than freshwater and often, in the deeper canals it is possible to find a wedge of saltwater pushing northward under freshwater. In the Mississippi River these wedges of saltwater have been observed as far north as Baton Rouge, Louisiana. Marsh crawfish farmers should definitely be aware of this stratification in the placement of their intake pumping lines.

Usually a person can tell a great deal about water and soil salinities experienced in areas by observing certain indicator plants. Soil and water conditions that are fresh enough to produce alligator grass, wild millet and sprangletop are usually fresh enough for crawfish culture.

Several coastal farmers have been surprised to find large numbers of blue crabs in their ponds. In one instance it was

reported that crabs completely out competed with the crawfish in a pond. These were most probably pumped into the pond by the farmers themselves as they are plentiful in the upper marshes during early fall.

After mating the female crabs move off shore with egg mass attached to the underside from December to October. They have two spawning peaks, one during March and April and one in June and July. The number of eggs produced in an egg mass may range from 700,000 to more than two million. Hatching takes approximately 15 days. Once hatched, crab larvae drift back into the marshes in swarms. The crabs at this point are about $1/2$ to $3/4$ the size of newly hatched crawfish and in one of the earlier stages actually resembles it. Newly hatched crabs will usually reach commercial size in one year.

If surface water is used to fill the pond, a very small mesh screen must be used to keep the young crabs out. The materials used should have at least 54 meshes or more (i.e. saran cloth) per inch. As an example of size, it is reported that a sock-like filter at least one foot in diameter and eight feet long is required for a 1,000 gallon per minute pump. A good alternate filter would be a four foot square box, three feet deep with saran cloth on the bottom and all four sides. Since the box would be partially submerged, the cloth would last longer being away from direct sunlight and pounding from the discharge. The pump intake should also

be screened with 1/4 to 1/2 inch hardware cloth.

There is no chemical known that will selectively kill crabs and be safe for crawfish in a flooded pond. However, during the summer months when the pond is dry, crabs may be eradicated from the catch basin by applying Ethyl or Methyl Parathion at a concentration varying from 0.25 to 0.50 ppm (parts per million). This chemical is highly toxic to crawfish as well as crabs and must be applied when there is no danger to them. Also, it is toxic to humans and should be handled with care.

Hurricanes and tropical storms pose a very definite threat to the coastal region from June until mid-November. The marsh farmer will have to respect the fact that possibly one day a hurricane may wipe out his whole operation. Over the past 15 years, five major hurricanes have struck the Louisiana coast greatly altering conditions in the region.

In summary, there are several thousand acres of marshlands suitable for crawfish culture. One of the major drawbacks aside from soil conditions toward successful operations has been salinity. Now that we have some idea of the salinity tolerance of crawfish, farmers that respect water quality may do quite well. A prime example is Pecan Island, Louisiana where approximately 1,000 acres of coastal marshlands has been devoted to crawfish culture.